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specimens soon mould; if covered by muslin the sand in a short time becomes too dry and the specimens, if they emerge at all, are apt to do so in a crippled condition. I have obviated these difficulties by boring a hole in the bottom of the jelly-glass or fruit-jar and setting it in a flower-pot saucer. By pouring a little water into the saucer from time to time, the sand in the jar can be kept moistened and the excessive wetting caused by pouring water upon the sand avoided. The holes in the glass are bored by means of the end of a broken rat-tail file wet with turpentine.

Other forms of new apparatus are in use, but they are not sufficiently perfected to warrant description at this time.—*John Henry Comstock.*

EMBRYOLOGY.[1]

Development of the Peripheral Nervous System of Vertebrates.—Dr. Beard[2] continues his important studies on this subject, which is just now interesting some of the most distinguished of living students of the general ontogeny of the vertebrates. His results as to the origin of the ganglia of the posterior sensory roots of the spinal nerves, and of the sympathetic system, are startling and unexpected. His discoveries may also be ranked as fundamental, and amongst the greatest of recent times, as regards their consequences. The following résumé of his conclusions is given in his own words:—

"The spinal ganglia of vertebrates are formed as differentiations of the inner layers of the epiblast just outside the limits of the neural plate. As the result of the cutting out from the epiblast of these ganglionic elements an appearance is presented by the epiblast which is left, to which Professor His gave the name of 'Zwischenstrang.' This has no share in the formation of the ganglia. The 'Zwischenrisme' of His has no existence, but certain portions of the cranial ganglia, called here neural ganglia, are developed from the epiblast before closure of the neural tube, *in exactly the same way as the spinal ganglia.* These portions of cranial ganglia are more or less homologous with spinal ganglia, possibly only with the sympathetic portion of the spinal ganglia 'Anlagen.' After separation from the epiblast, the neural cranial ganglia and the spinal ganglia get carried up with the closing in of the neural tube, and come to lie between its lips, but are quite distinct from the central nervous system, and the line of boundary between the two can always be distinguished. After the closure of the epiblastic folds the 'Anlagen' grow out of their position between the lips of the neural tube, and acquire their first and only connection with it by the probable growth of fibres from the ganglia into the central nervous system. The neural cranial ganglia also grow towards the lateral epiblast at the level of the notochord, and fuse with it. Here are the Anlagen of the lateral or branchial sense organs of Froriep and myself. From this fusion in all vertebrates form-elements pass into the cranial ganglia; these form-elements I distinguish as lateral ganglia. The parapodial ganglia of Annelids appear to be homologous with the spinal ganglia of vertebrates, as Kleinenberg suggested, and also more or less with the neural cranial ganglia.

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[1] Edited by Prof. Jno. A. Ryder, Univ. of Penna., Philadelphia.

[2] Morphological Studies, II. The development of the peripheral nervous system of vertebrates, Part I., Elasmobranchs and Aves, Quar. Journ. Mic. Science, xxix., pt. ii., 1888, pp. 153-227, pls. xvi.-xxi. By J. Beard, Ph.D., B.Sc.

"The anterior roots of cranial and spinal nerves arise as outgrowths of ganglia situate in the central nervous system. To form them, cells leave the nervous system and are distributed in the nerve. All the anterior roots at first contain many nuclei, which are of nervous and not parablastic origin. These statements on the anterior roots are only a confirmation of Balfour's researches.

"In addition to the four elements of the anterior and posterior roots, two ganglionated and sensory, two motor and unganglionated, distinguished by Gaskell, Hill, and partially by His, the cranial nerves contain a fifth element, derived from the lateral or branchial sense organs. Such are, in very brief form, the main results of the researches recorded in the preceding paper."

Dr. Beard shows that the so-called "neural ridge" of Balfour is developed from a portion of the epiblast hitherto overlooked by embryologists, and extending along either side of the medullary plate, and that it precedes by a very considerable interval of time the appearance of the "neural ridge" to which it gives rise and from which the spinal and sympathetic or neural ganglia are subsequently developed.

Further observations have been communicated by Dr. Beard to the *Anatomischer Anzeiger*, III., No. 29, 1888, pp. 875–884 (to be continued in No. 30) on this same subject. His completed results will be published in three parts: Part I., discussing the development of the peripheral nerves in Elasmobranchs and Birds; Part II., Frog, Triton and Lacerta; Part III., Mammalia. Of these, only Part I. has yet appeared in the journal cited below in full.

It is stated in the conclusion of the first part of the article in the *Anatomischer Anzeiger* (p. 884), "It can be proved embryologically that of the following cranial ganglia each and every one is made up of two parts, a neural part and a lateral part, which are developed respectively from the sources mentioned above, Olfactory ganglion, mesocephalic, trigeminus, facial, auditory, glossopharyngens, and vagus complex." In a foot-note it is stated, "I hope soon to show that the end-organs of taste arise from such thickenings [of the sensory epithelium] which have wandered through certain gill-clefts into the buccal cavity" (*Anat. Anz.*, p. 879).

A NEW ATLAS OF EMBRYOLOGY.—Nothing to compare with the splendid atlases of Coste on Comparative Embryology, and of His on the human embryo, has yet been published on the Chick. This desideratum will be met by the *Atlas d'Embryologie*, by Mathias Duval, just announced by G. Masson, Paris. The author has done wisely in keeping it in quarto form, and with forty plates, embracing 652 figures, it will cover the history of bird development very fairly. The first plate gives views of the egg in the ovary and oviduct, and the chick in the egg nearly ready to hatch, in short, a "vue d'ensemble de sujèt." The next two plates are devoted to the structure of the egg, segmentation and formation of the blastoderm. Plates IV. to X. show surface views of the blastoderm and embryo at successive stages. Plates XI. to XL. are devoted to representing sections of the successive stages shown entire on Plates IV. to X. Facts only are presented, theoretical considerations being left to the student after he has mastered the data. The whole is provided with a copious index, and also contains an account of the necessary embryological technique involved in a study of the development of the chick. The reviewer predicts that Professor Duval's work will be welcomed by teachers as a very useful help in the practical study of the subject in the laboratory. The book will be useful for reference to supplement other manuals, and, as it seems to the writer, a thorough knowledge of the embryology of the chick will best serve as an introduction to the wider field of comparative embryology. The appearance of this atlas is timely, for it is probable that eventually embryology will have to be taught in order to enable the beginner in morphology to understand the significance and relative importance of the data of advanced morphology in general.

In taking a survey of the field of embryology, as covered by the existing literature, one is struck by the fact that, in spite of the great activity of the individual workers, but few really exhaustive monographs provided with adequate atlases are in existence. Such beautiful embryological monographs as Goette's on Bombinator, of Reichenbach on the Cray-fish, are lasting contributions to science; the works of Selenka and Whitman, too, and, amongst the productions of the older workers, the great monographs of Von Baer, Rathke and Bischoff, must ever command admiration. Complete as some of these are, we are still deplorably deficient in monographies which serve to illustrate the later or post-embryonic changes, intervening between the last stages with which the embryologist cares to concern himself, and the point where the organism becomes adult, when it is supposed that the scalpel of the anatomist is all-sufficient in prosecuting farther inquiry. This is unfortunate, since the details of the final metamorphosis of whole systems of organs, even in animals as thoroughly studied as the chick, is in some cases scarcely at all known, or so imperfectly as to be nearly the same as if altogether unknown. The external features of the development of the skeleton of the chick are pretty well known, but the internal and histological changes, and the development of pneumaticity of the bones, quite imperfectly.

Now that serial sections may be so easily prepared and photographed upon an enlarged scale, it is strange that no one has yet undertaken to prepare sets of uniformly enlarged photographs of series of sections, arranged in a folio in the order in which they were cut, of the most important stages of the development of the chick, and thus supply a more satisfactory iconography of the embryology of this animal than we yet possess. Series of enlarged photographs of serial sections, arranged as suggested, if made with care, would serve almost as well for purposes of reconstruction as the modelling method of Born, or the method of graphic isolation proposed by Kastschenko. It would, in fact, make it possible to inspect series of sections of an organism with as much readiness and as minutely as one is enabled to inspect the successive pages of a book. In fact, the topography or relations of the organs, as well as some notion of their histological composition, in an embryo, in successive planes, could be as readily got at in this way as the text imprinted upon the pages of a book. If thin gelatine positives of such series were properly prepared, protected, and arranged in their proper serial order, in the form of a roll, series of sections could be projected, one section after the other in succession, upon a screen for purposes of lecture demonstration, in a manner far more effective than would be possible with the most complete serial sets of diagrams.—*J. A. R.*